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A study on postoperative analgesic effects of intra articular ropivacaine and femoral nerve block in unilateral total knee replacement surgery

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Abstract

Introduction: Pain after total knee replacement surgery if not taken care of properly may interfere with early mobilization and recovery process. Infiltrating an anesthetic agent in the joint at the end of surgery is gaining popularity nowadays. So we compared the effects of intraarticular ropivacaine infiltration and single shot femoral nerve block for better post operative pain relief.

Materials and Methods: 60 patients aged 50-75years Scheduled for unilateral total knee replacement surgery under spinal anesthesia were divided in 2 groups. Group I received 150 ml ropivacaine 0.2% (2mg/ml) as an intra-articular infiltration in knee and Group F received single shot femoral block with 0.25% ropivacaine 30ml after surgery. Pain intensity was measured on "Visual Analogue Score" at rest and during passive movement of limb. Rescue opioid consumption and weight bearing ability recorded in all patients for 24hrs postoperative.

Results: Group I subjects had low pain score throughout post operative period (till 24 hours) as compared to group F at rest ($p>0.05$) as well as with passive limb movements ($p<0.05$). Average consumption of rescue opioid was less among group I (371.83mg ± 99.53) compared to group F (443.66mg ± 96.56) ($p<0.05$). 17 patients could stand on their feet within 24 hours postoperative in group I while only 8 from group F ($p<0.05$).

Conclusion: Intra articular ropivacaine infiltration and femoral nerve block both provided similar analgesia at rest. However during passive movement of limb intra articular infiltration of ropivacaine provides better analgesia which decreased overall consumption of opioid and helped patients in bearing weight.

Keywords: Femoral nerve block, Intra articular infiltration, Total knee replacement, Analgesia

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Introduction

Early mobilization, reduction in the hospital stays and optimized pain control are need of the hour after any surgical procedure. Total knee replacement is a common surgical procedure that can lead to severe post operative pain. Inadequate pain control may hinder early mobilization and also affect functional outcome.(1) For many years epidural analgesia or continuous peripheral nerve blocks have been cornerstone for post operative analgesia. Nowadays there has been increased interest in intra articular local infiltration techniques.(2) Intra operative local infiltration of an analgesic agent reduce post operative pain intensity and rescues intravenous opioid consumption in comparison to intravenous opioid alone as post operative analgesia.(1) It has been reported that sciatic nerve block with femoral block is superior to local infiltration analgesic with femoral block in early postoperative period.(3) Periarticular local infiltration is simple technique, which can be performed by the surgeon also and does not require ultrasound machine. In recent years a modified technique of local infiltration analgesia, developed by Kerr and Kohan for total knee replacement is gaining popularity.(4) In this high Volume of intra operative local infiltration analgesia is used, often in combination with post operative intra-articular injection of local anesthetics. Since number of new techniques and anesthetic agents are being used to reduce post operative pain, we decided to compare analgesic effects of ropivacaine given as an intra articular local infiltration (IALA) at the end of surgery against the femoral nerve block (FNB).

Aims and Objectives

1. Comparison of post operative analgesic effects of an anesthetic agent given as intra articular local infiltration and femoral nerve block in total knee replacement surgery.
2. To find out time spent without need of rescue analgesia in postoperative period among both the groups.

Materials and Methods

The study was approved by the institutional review board. 60 patients undergoing total knee replacement (TKR) surgery were enrolled for study after taking informed written consent.

Inclusion criteria:

- Age: 50-70 years
- Weight: 40-99 kilograms
- Primary unilateral total knee replacement surgery under planned spinal anesthesia
- ASA physical status I-III.

Exclusion Criteria:

- Patients having any psychiatric illness, known case of allergy, intolerance to study drugs (bupivacaine, ropivacaine, tramadol), bleeding disorders,

rheumatoid arthritis and those who are consuming opioids on daily basis.

- Weight: more than 100 kilograms
- ASA physical status IV and more
- Intra operative conversion to general anesthesia

60 patients were divided in 2 groups by computer-generated randomized numbers with allocation ratio of 1:1.

Group I: Intra articular infiltration of an anesthetic agent (IALA)

Group F: Femoral nerve block (FNB)

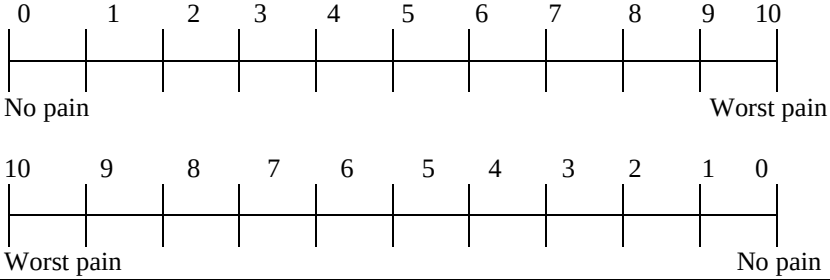
On the day of surgery patients were shifted to the operation theatre and all routine monitors like non-invasive blood pressure, electrocardiogram, and pulse oximeter were attached. All patients were premedicated with injection Ondensetron 0.15 mg/kg and preloaded with 0.9% normal saline 10 ml/kg over 15 minutes. Patients were placed in Lateral position. After aseptic preparation local infiltration of L3-L4 interspace with 2 ml of 0.2% lignocaine was done. Sub arachnoid block was achieved with a 25- gauge Quincke's spinal needle. After confirmation of free flow of CSF hyperbaric bupivacaine 0.5% 3 ml was injected. Patients were monitored continuously for hemodynamic parameters and oxygen saturation. Oxygen supplementation with venturi mask was provided, whe required. Surgeon was allowed to proceed after achieving successful spinal block. Among 2 groups, Group I received 150 ml Ropivacaine 0.2% (2mg/ml) as intra-articular infiltration. In this technique, Surgeon injected total volume of drug preloaded in 3 syringes containing 50 ml ropivacaine in each, after cementing of modular prosthesis at posterior, medial & lateral capsule, collateral ligaments. In Group F all patients were given femoral nerve block at the end of surgery. The block was given using neurostimulation (minimum intensity < 0.5mA), under ultrasound guidance with 22 gauge insulated needle of 10 cm long. Keeping patient in supine position with leg extended, standing right side for right femoral nerve block and left side for left; injection ropivacaine 0.25% 30ml was injected through this needle under the femoral sheath. All surgeries were performed by same orthopedic team and same Anesthesiologists. Both operator and investigator were kept blind about the techniques of analgesia, which was performed by an independent investigator. Patients were observed for 24 hours postoperative. Hemodynamic parameters were monitored at regular intervals. Pain assessed at rest and upon passive limb movement on 0-10 point Visual analogue scale (VAS), in which 0 means no pain and 10 means worst pain. Weaning of Sub arachnoid block was assessed by checking sensory and motor block at every 30 minutes and findings were recorded. Duration of sensory block was calculated by return of sensation up to T_{12} level in non-operated limb and duration of motor block calculated by return of Bromage score 6. Patients were assessed for pain two hrs after the sub arachnoid block. Finding of VAS $\geq$ 4 any time post operative was considered as inadequate analgesia. Recording of VAS $\geq$ 4 or request of rescue analgesia irrespective of pain score by the patient was marked as weaning of femoral nerve block or intra – articular local analgesic infiltration effect. Intravenous injection of Tramadol 1-2mg/kg was given for rescue analgesia. Physiotherapy (passive movement) was started at 4th hour, post operatively.

Modified Bromage Scale:[5]

Score	Criteria
1	Complete block (unable to move feet or knees)
2	Almost complete block (able to move feet only)
3	Partial block (just able to move knees)
4	Detectable weakness of hip flexion while supine (full flexion of knees)
5	No detectable weakness of hip flexion while supine
6	Able to perform partial knee bend

Visual Analogue Scale:[6] A 10 cm line having verbal anchors at both the ends was used to assess post-operative pain. The technique is known as VAS i.e. Visual Analogue Scale. Scoring was accomplished by having the patient mark on the line on both 0-10 & 10-0 lines. Mark 0 corresponded to 'no pain' and mark 10 corresponded to the 'worst imaginable pain.' Recording was done on an hourly basis.

Pain Scale



Statistical Analysis: Results obtained from the study were expressed in mean ± SD, for categorical data Chi square test was applied and for continuous variables un-paired 't' test was applied. "*P*" value less than 0.05 was considered as statistically significant. The software SPSS 17.0 was used for analysis. (SPSS 17.0 for windows, SPSS Inc., Chicago, IL, USA). Sample size was estimated based on power calculation which showed that at least 22 subjects per group were necessary to achieve 80% power with an expected mean difference of 25% between two groups in intravenous opioid consumption and alpha error 0.05.

Results

Table 1: Demographic profile of both the groups

	Group I (n=30) (mean ± SD)	Group F (n=30) (mean ± SD)	p-value
Age (years)	64.29 ± 6.80	65.29 ± 5.96	0.5312
weight (kg)	66.36 ± 5.32	64.36 ± 5.95	0.1974
Sex	13:17	16:14	0.56
Duration of surgery (minutes)	99.45 ± 10.78	102.28 ± 8.56	0.2648
ASA Grade	2.10 ± 0.45	1.95 ± 0.39	0.506

Table 2: Pain score (VAS) comparison in both groups in recovery room (at rest)

Time	Group I (n=30) (mean ± SD)	Group F (n=30) (mean ± SD)	p-value
1 hour	0.26 ± 0.26	0.29 ± 0.50	0.771
2 hour	0.6 ± 0.72	0.93 ± 0.59	0.057
4 hour	1.03 ± 0.71	1.33 ± 0.66	0.095
6 hour	2.4 ± 0.62	2.18 ± 0.77	0.227
8 hour	2.8 ± 0.55	3.01 ± 0.57	0.104
10 hour	3.9 ± 0.75	4.14 ±0.83	0.244
12 hour	4.53 ± 0.86	4.86 ± 0.89	0.149
16 hour	5.01 ± 0.93	5.41 ± 0.99	0.112
20hour	5.56 ± 0.98	5.61 ± 1.10	0.853
24 hour	6.01 ± 1.01	6.12 ± 1.15	0.693

Table 3: Pain score (VAS) comparison in both groups in recovery room (during passive movement of operated limb)

Time	Group I (n=30) (mean ± SD)	Group F (n=30) (mean ± SD)	p-value
4 hour	3.2 ± 0.96	3.93 ± 0.77	0.001
6 hour	4.11 ± 0.88	4.98 ± 0.98	0.006
8 hour	4.53 ± 0.62	5.05 ± 0.57	0.001
10 hour	5.22 ± 0.71	5.80 ± 0.82	0.005
12 hour	5.5 ± 0.62	6.23 ± 0.89	0.0005
16 hour	6.03 ± 0.55	6.88 ± 0.79	<0.0001
20 hour	6.46 ± 0.57	7.09 ± 0.69	0.0003
24 hour	6.73 ± 0.63	7.23 ± 0.72	<0.0001

Table 4: Amount of rescue analgesia (Tramadol) consumed among both the groups

	Group I (n=30) (mean ± SD)	Group F (n=30) (mean ± SD)	p-value
Tramadol (mg)	371.83 ± 99.53	443.66 ± 96.56	0.0063

Table 5: Number of patients achieved full weight bearing (standing) till 24 hours

Group I	Group F	P-value
17/30	08/30	0.0362

Discussion

Primary outcome from our study suggests that there is no difference in the degree of analgesia felt by either group at rest, but intra articular ropivacaine infiltration provides better pain relief than femoral nerve block during passive movement of limb for physiotherapy. Opioid consumption was significantly lower among group I than group F till 24 hours postoperatively. 17 out of 30 patients of group I and 8 out of 30 of group F were able to stand on their feet within 24 hours postoperative.

As per Table 1 both the groups are comparable for baseline characteristics (p>0.05). Uncontrolled post operative pain has been found to be a most common factor related to patient dissatisfaction after total knee replacement.[7,8] In our study, we found no difference in pain perception at rest (Table 2; p<0.05). However there was less pain score throughout 24 hours postoperative in IALA group (Haytham Rizk et al. 2015).[9] Another study suggests, "Low pain score till 6 hours postoperative among IALA group but FNB group had low pain score at 12 hours postoperative (Moghtadei et al. 2014)."[10] Probable reason for such beneficial result would be usage of ropivacaine, ketorolac and epinephrine combination in their study. Ketorolac has anti inflammatory property that helps to reduce pain.

Early initiation of physiotherapy and weight bearing remains primary objective after knee replacement surgery which is only achievable if pain is less. Intra articular ropivacaine infiltration provides better analgesia upon passive limb movement and consequently less opioid consumption in our study (Table 3; Table 4 p<0.05). However previous studies suggest no such benefits, "No statistical significant difference in pain score and opioid consumption with IALA (Rosen et al. 2010)."[11] Similar results also noted by Browne et al. 2004.[12] Browne et al.[12] had used bupivacaine in their study and Rosen et al[11] had used 200 mg ropivacaine in their study. We used high dose of ropivacaine (300mg) which might have given beneficial results. However few studies Ashraf et al.[13] Moghtadei et al.[10] and Affas et al.[14] noted reduced opioid consumption as well.

Pain must be in control if early rehabilitation and reduced hospital stay is expected after total knee replacement.[15] In our study 17 (56.66%) Group I subjects were able to stand on their feet in comparison with only 8 (26.66%) of group F within 24 hours postoperative (Table 5; p<0.05). Better result was probably attributed to less pain experience during passive limb movement among the former. Early mobilization, moreover by reducing prolonged bed rest, decreases decubitus related complications and helps in early discharge from hospital.[16,17] However in our study we haven't determined the length of hospital stay. Delayed weight bearing among group F may be because of femoral nerve blockade leading to quadriceps muscle inhibition.[18] Local infiltration analgesia does not cause such motor effects and also avoid the complications of peripheral nerve blockade.[19] Antoni M. et al.[20] and Karen T. et al.[21] also noted delayed weight bearing and assisted walking due to femoral nerve blockade.

Conclusion

From our study we conclude that intra articular infiltration of ropivacaine and femoral nerve block provide similar analgesia at rest postoperatively in total knee replacement patients however former regimen has advantage over later in terms of better pain control with movement of limb, less opioid consumption and early weight bearing.

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